CLAIMS

We claim:

1.   A computer program product recorded on computer readable medium for organizing and manipulating Web services (hereinafter "container"), comprising:

computer readable code for determining and describing Web services that are available at a corresponding network node;

computer readable code for transmitting to other containers messages via a network disclosing said Web services that are available at said corresponding network node;

computer readable code for receiving and deciphering messages disclosing Web services that are available at other network nodes corresponding to other containers; and

computer readable code for dynamically reconfiguring Web services based on said messages and said Web services available at said corresponding network node;

wherein said computer program product is in the form of a Web service.

2.   The computer program product of Claim 1 wherein said computer readable code for dynamically reconfiguring Web services comprises:

computer readable code for transmitting messages to said other containers requesting said other containers to return copies of Web services software; and

computer readable code, responsive to receipt of messages from said other

containers requesting copies of Web services software, for sending said requested

Web services software to said requesting containers.

3.   The computer program product of Claim 2 wherein said computer

readable codes for transmitting and receiving said messages disclosing said Web

services that are available generate messages that are hardware and software platform

independent.

4.   The computer program product of Claim 3 wherein said computer

readable codes for transmitting and receiving said messages disclosing said Web

services that are available comprises computer readable code for transmitting and

receiving said messages to and from a Web services registry.

5.   The computer program product of Claim 4 wherein said messages

disclosing said Web services that are available at network nodes are in the Web

Services Descriptor Language (WSDL).

6.   The computer program product of Claim 5 wherein said registry is a

Universal Description, Discovery, and Integration initiative (UDDI) registry.

7.   The computer program product of Claim 3 wherein said computer

readable codes for transmitting and receiving said messages disclosing said Web

services that are available at network nodes comprise computer readable codes for

sending and receiving said messages using a peer to peer messaging protocol

between said containers.

8.   The computer program product of Claim 7 wherein said messaging

protocol is SOAP.

9.   The computer program product of Claim 8 wherein said disclosures of

said Web services that are available at network nodes are contained in headers of

Simple Object Access Protocol (SOAP) messages.

10.   The computer program product of Claim 7 wherein said messaging

protocol is JXTA.

11.   The computer program product of claim 3 further comprising:

computer readable code for receiving requests for Web services from client

computers via said network.

12.   The computer program product of claim 11 wherein said computer

readable code for dynamically reconfiguring Web services comprises:

computer readable code that, responsive to receipt of a request from a client for

a Web service that is not available at said corresponding network node;

determines, based on said received messages disclosing said Web

services that are available at network nodes, what network nodes have copies of

said particular Web service; and

invokes a proxy to another of said containers having a copy of a particular

Web service based on said determination.

13.   The computer program product of claim 12 wherein said proxy comprises:

computer readable code for routing client requests for said particular Web

service to said other of said containers;

computer readable code for receiving responses to said requests; and

computer readable code for returning said responses to said requesting clients.

14.   The computer program product of claim 13 further comprising:

computer readable code for receiving said requests forwarded from other of said

containers and causing said requests to be handled by said copy of said particular

Web service corresponding to said computer program product to generate said

response; and

computer readable code for transmitting said response to said container that

issued said request.

15.   The computer program product of claim 11 further comprising:

computer readable code for determining a load of client requests at said corresponding network node; and

wherein said computer readable code for dynamically reconfiguring Web services performs said dynamic reconfiguration based on said load determination.

16. The computer program product of claim 15 wherein said computer readable code for dynamically reconfiguring Web services further comprises:

computer readable code that, responsive to determination of a load of client requests for a particular Web service that is not available at said corresponding network node exceeding a predetermined level, issues a request for a copy of the code of said particular Web service from another container that has a copy of said particular Web service;

computer readable code for receiving and locally invoking said code for said particular Web service from said other container; and

computer readable code for routing client requests for said particular Web service to said local invocation of said code for said particular Web service.

17. The computer program product of claim 16 wherein said computer readable code for dynamically reconfiguring Web services further comprises:

computer readable code for offloading said local code for said particular Web service responsive to said load of client requests for said particular Web service dropping below a second predetermined level.

18.   The computer program product of claim 15 wherein said computer readable code for dynamically reconfiguring Web services comprises:

computer readable code that, responsive to determination of a load of client requests for a particular Web service available at said corresponding network node exceeding a predetermined level, issues a request for another container to accept a copy of the code of said particular Web service from said computer program product; and

computer readable code for sending a copy of said code of said particular Web service to said other container responsive to affirmative responses to said request.

19.   The computer program product of claim 18 wherein said computer readable code for dynamically reconfiguring Web services further comprises:

computer readable code for reconfiguring said computer program product to route client requests for said particular Web service to said other container.

20.   The computer program product of claim 19 wherein said other container comprises a plurality of other containers.

21.   The computer program product of claim 20 wherein said computer readable code for reconfiguring said computer program product to route client requests for said particular Web service to said other container distributes said client requests for said particular Web service between said other containers and said local invocation

of said particular Web service.

22.   The computer program product of claim 11 wherein said client requests

indicate whether said requesting client has a container and a platform on which said

client is running and wherein said computer program product further comprises

computer readable code to read said client requests to determine whether said client

has a container and said platform.

23.   The computer program product of claim 22 wherein said computer

readable code for dynamically reconfiguring Web services further comprising:

computer readable code for sending a copy of the code of a particular Web

service responsive to a client request for said Web service.

24.   The computer program product of claim 11 further comprising:

computer readable code for monitoring usage of Web services by clients; and

computer readable code for charging said clients for said usage.

25.   A method for organizing and manipulating Web services, comprising the

steps of:

(1) determining and describing Web services that are available at a

corresponding network node;

(2) transmitting messages via a network disclosing said Web services that are

available at said corresponding network node to other network nodes via said network;

(3) receiving and deciphering messages disclosing Web services that are available at other network nodes; and

(4) dynamically reconfiguring Web services based on said messages and said Web services available at said corresponding network node;

wherein said computer program product is in the form of a Web service.

26. The method of Claim 25 wherein step (4) further comprises:

(4.1) transmitting messages to said other network nodes requesting said other network nodes to return copies of Web services software; and

(4.2) computer readable code, responsive to receipt of messages from said other network nodes requesting copies of Web services software, for sending said requested Web services software to said requesting network node.

27. The method of Claim 26 wherein said messages of steps (2) and (3) are hardware and software platform independent.

28. The method of Claim 27 wherein steps (2) and (3) comprise sending and receiving said messages to and from a Web services registry.

29. The method of Claim 28 wherein said messages disclosing said Web services that are available at network nodes are in the Web Services Descriptor

Language (WSDL).

30.   The method of Claim 29 wherein said registry is a Universal Description, Discovery, and Integration initiative (UDDI) registry.

31.   The method of Claim 27 herein steps (2) and (3) comprise sending and receiving said messages using a peer to peer messaging protocol between said network nodes.

32   The method of Claim 31 wherein said messaging protocol is SOAP.

33   The method of Claim 32 herein said disclosures of said Web services that are available at network nodes are contained in headers of Simple Object Access Protocol (SOAP) messages.

34   The method of Claim 31 herein said messaging protocol is JXTA.

35.   The method of claim 27 further comprising the step of:

(5) receiving requests for Web services from client computers via said network.

36.   The method of claim 35 wherein step (4) further comprises:

(4.3) responsive to receipt of a request from a client for a Web service that is not

available at said corresponding network node;

determining, based on said received messages disclosing said Web

services that are available at network nodes, what network nodes have copies of

said particular Web service; and

invoking a proxy to another of said network nodes having a copy of a

particular Web service based on said determination.

37. The method of claim 36 wherein said proxy performs the steps of:

(4.3.1) routing client requests for said particular Web service to said other of

said network nodes;

(4.3.2) receiving responses to said requests; and

(4.3.3) returning said responses to said requesting clients.

38. The method of claim 37 further comprising:

(6) receiving said requests forwarded from other of said network nodes and

causing said requests to be handled by said copy of said particular Web service

corresponding to said network node to generate said response; and

(7) transmitting said response to said network node that issued said request.

39 The method of claim 35 further comprising:

(8) determining a load of client requests at said corresponding network node;

and

wherein, in step (4), said dynamic reconfiguration is performed based on said load determination.

40.   The method of claim 39 herein step (4) further comprises:

(4.4) responsive to determination of a load of client requests for a particular Web service that is not available at said corresponding network node exceeding a predetermined level, issuing a request for a copy of the code of said particular Web service from another network node that has a copy of said particular Web service;

(4.5) receiving and locally invoking said code for said particular Web service from said other network node; and

(4.6) routing client requests for said particular Web service to said local invocation of said code for said particular Web service.

41.   The method of claim 40 wherein step (4) further comprises:

(4.7) offloading said local code for said particular Web service responsive to said load of client requests for said particular Web service dropping below a second predetermined level.

42.   The method of claim 39 wherein step (4) comprises:

(4.8) responsive to determination of a load of client requests for a particular Web service available at said corresponding network node exceeding a predetermined level, issuing a request for another network node to accept a copy of the code of said

particular Web service from said network node; and

(4.9) sending a copy of said code of said particular Web service to said other

network node responsive to affirmative responses to said request.

43.   The method of claim 42 wherein step (4) further comprises:

(4.10) reconfiguring said network node to route client requests for said particular

Web service to said other network node.

44.   The method of claim 43 wherein said other network node comprises a

plurality of other network nodes.

45.   The method of claim 44 wherein step (4.10) comprises distributing said

client requests for said particular Web service between said other network nodes and

said local invocation of said particular Web service.

46.   The method of claim 35 wherein said client requests indicate a platform

on which said client is running and wherein said method further comprises the step of:

(9) reading said client requests to determine said platform of said client.

47.   The method of claim 46 further comprising the step of:

(10) sending a copy of the code of a particular Web service responsive to a

client request for said Web service.

48.   The method of claim 35 further comprising the steps of:

(11) monitoring usage of Web services by clients; and

(12) charging said clients for said usage.